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THE CENTRAL VALLEY BASIN OF CALIFORNIA

Public Health Service
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REPORT ON

THE CENTRAL VALLEY RIVER BASIN OF CALIFORNIA

for the

PRESIDENT'S WATER RESOURCES POLICY COMMISSION

Prepared by the

California and Great Basin Drainage Basin Office
Division of Water Pollution Control

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THE CENTRAL VALLEY BASIN OF CALIFORNIA

PART I

PHYSICAL AND ECONOMIC DATA

Description of the Basin

The Central Valley Basin includes more than one-third of California comprising the drainage areas of the Sacramento and San Joaquin Rivers. These two principal river systems join in the Sacramento-San Joaquin Delta with a common outlet to San Francisco Bay. The combined basin extends about 500 miles in a northwest-southeast direction between the high, snow-capped Sierra Nevada Mountains and the relatively low Coast Range Mountains. The average width of the Basin is 120 miles. The valley floor is a gradually sloping, fertile alluvial plain of about 12 million acres. The area of the surrounding mountainous portion of the Basin is about 22 million acres drained by sixteen major cold-water tributaries.

Off-shore air pressure changes cause high rainfall in winter and low precipitation during summer. Available moisture decreases southward on the valley floor from 23 inches at Red Bluff in the Sacramento Valley to 6 inches at Bakersfield in the San Joaquin Valley. In the Sierra Nevada Mountains, the variation in rainfall is from about 80 inches in Northern Sacramento Valley to 35 inches in the mountains east of Bakersfield. Winter rainfall and melting snow in spring cause high run-off and correspondingly high waste of needed water. Water storage and irrigation facilities are necessary for flood control and maximum land use.

In general, the stream flows at the edges of the Central Valley are of excellent quality. Ground water supplies are also of good quality with the exception of certain zones of unsatisfactory water in the west side upper San Joaquin Valley. Here, the water table is lowering rapidly and the California State Division of Water Resources estimates a water table drop in the Upper San Joaquin Valley of 7.6 feet for the year ending October 1947. A comparable figure for the Sacramento River Valley is 4.4 feet. Drops of more than 10 feet have been recorded in four districts. It is estimated that water now wasted to the ocean would be sufficient to maintain the ground water level.

From 1940 to 1948, the population of the Basin increased 44 percent, namely from 1,323,000 to 1,905,000. In 1948, there were nine cities of 10 thousand or more people, amounting to about 20 percent of the total population of the Basin.

Agriculture in the Central Valley is now highly specialized and largely dependent upon irrigation. The valley contains 15,500,000 acres of agricultural land, and in 1948 produced farm products valued at $1,080,000,000 or half of the total for the State. Only 22 percent of the agricultural land in the Valley is under irrigation, but the irrigated land yields over 90 percent of the total farm income in the Valley and represents 15 percent of all the irrigated land in the United States.

Diversification of agriculture is indicated by the orange groves of Tulare County, the cotton fields near Bakersfield, the vineyards of Fresno County, the rice fields of the Colusa Basin, the almond groves around Chico, the asparagus fields of Sacramento County and the alfalfa fields of Kern County. Livestock and livestock products are a major source of income in 30 percent of the Valley's farms. Fruits and nuts are also of primary importance as indicated by the 240 million dollar crop of 1948.

The Central Valley, famous for its scenic and recreational attractions, includes all or parts of 12 national forests having an area of some 11 million acres and covering the major portion of the mountainous watershed, 4 national parks with a combined area of 1.5 million acres and located on the western slopes of the Sierra Nevada Mountains, 2 national monuments, 4 small state forests embracing a total area of approximately 14 thousand acres, 10 or more state parks, 4 state wildlife refuges, 4 national refuges and several Indian reservations. Reservoirs constitute an additional recreational attraction.

Harnessing of the water resources of the Basin for irrigation and hydroelectric power has resulted in industrial expansion of the Central Valley paralleling the expansion in agricultural production. The leading industries are canning and packing of agricultural products, and mining.

In 1947, there were over 1,600 manufacturing establishments in the Central Valley, more than one-half of which processed foods, largely fruit and vegetables. Petroleum and gold are mined extensively and in the mountain areas lumbering is an important industry. In 1946 there were approximately 500 lumber manufacturing establishments with an annual output of over 1,600,000,000 board feet of lumber.

Conservation and utilization of the water resources of the Basin is the key to further economic development of the Central Valley. The Central Valley Project under development by the Bureau of Reclamation will equalize and conserve the water resources by a vast scheme of storage and redistribution of waters in the Valley. An adequate program of pollution control is essential to assure waters of satisfactory quality for domestic, industrial, agricultural, and other uses.

Sources of Pollution

The surface streams of the Central Valley receive the waste discharged from 158 communities and 61 industries as indicated in the following table.

Source	Number	Amount of Pollution Contributed: Estimated No. of People Served c/	Amount of Pollution Contributed: Pop. Equivalent of Wastes Discharged to Watercourse d/
Municipalities a/	158	702,000	480,000
Industrial Plants b/	61	---	*2,143,000
Total	219		2,623,000

* The population equivalent of industrial wastes discharged was estimated for the larger industries from known plant capacities or annual production where actual Biochemical Oxygen Demand values of wastes are unknown.

a/ Includes incorporated and unincorporated municipalities; other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers and other population centers. (This pollution includes the industrial waste discharged into municipal sewerage systems.)

b/ Industries discharging wastes directly to watercourse.

c/ Latest estimated population.

d/ In reducing to a common basis certain wastes from industries and municipalities, it is common practice to express the non-similar wastes in terms of a common unit, Population Equivalent.

The wastes reaching the surface streams are equivalent to the raw sewage discharges from approximately 2,623,000 persons. About 75 percent is contributed by the food processing industries which are seasonal and reach peak production during the summer months when stream flows are at a minimum. Much of the pollutional load is contributed at Modesto, Stockton and Sacramento. Modesto and Stockton are constructing treatment works at the present time to treat both domestic and industrial wastes. Sacramento to date has only had preliminary engineering studies made toward treatment of its domestic wastes from 125,000 persons and industrial wastes with a population equivalent in excess of 1,000,000.

The water in the San Joaquin River below Stockton and in the Sacramento River below Sacramento is so heavily polluted that it is unsatisfactory as a source of public water supply and can be used for most industrial processes only after expensive treatment. A serious typhoid fever epidemic occurred at Pittsburg, near the mouth of the San Joaquin River, in 1920 caused by failure of the chlorination equipment in treatment of the San Joaquin River water. The city abandoned the River as a source of supply and used highly mineralized water from wells until water of better quality became available from the Contra Costa Canal.

The food processing industries have done little toward treatment of their own wastes, but many cities have made considerable progress toward separation of industrial wastes from domestic wastes. Stockton is treating industrial wastes with a population equivalent of 250,000 along with domestic wastes from 37,000 population in their new south treatment plant. Separate industrial waste treatment by lagooning or land disposal methods has been adopted by several cities, but in some cases the land area available is inadequate and the peak industrial waste flow is discharged directly to surface streams.

In addition to sewage and industrial wastes, the rivers of the Central Valley are polluted to some extent by mine wastes and by silt from hydraulic mining and farming operations. There have been reports of fish kills from abandoned copper mine wastes discharged to the Sacramento River below Shasta. Fish are also killed each year in the San Joaquin River when peak industrial waste discharges reduce the dissolved oxygen content of the water below the limit of tolerance.

Water Use and Adequacy of Water for Indicated Uses

About 51 percent of the water resources of the State are in the Central Valley. The 40 year average run-off from the Central Valley streams averages 33,000,000 acre-feet annually, much of

which is wasted to San Francisco Bay. Thirty-six (36) large reservoirs with a total storage capacity of 10,000,000 acre-feet have been constructed in addition to numerous smaller reservoirs to conserve the storm run-off. Current proposals call for the construction of 25 additional reservoirs with 11,000,000 acre-foot storage capacity.

By far the greatest water use in the Central Valley is for irrigated agriculture. During normal years 3,400,000 acres of land are irrigated in the Valley requiring 8,500,000 acre-feet of water annually. Approximately 60 percent of the water supply comes from natural or regulated stream flow and the remaining 40 percent comes from 32,000 irrigation wells. The area under irrigation could be almost doubled if the necessary additional water could be made available. Seventy percent of the remaining irrigable land lies in the San Joaquin Valley, and water to develop the area must be imported from the Sacramento Valley. A minimum of 3,300 second-feet of the surplus water from the Sacramento Valley is also required to maintain navigation and to repel salt water intrusion into the rich delta area.

Approximately 217,000 persons in 37 communities within the Valley obtain their domestic water supplies from the Sacramento and San Joaquin Rivers or their tributaries. In addition most of the water supply for 1,720,000 persons living in the San Francisco Bay area is imported from the Mokelumne and Tuolumne Rivers of the Central Valley. An additional 600,000 persons living in 85 communities in the Central Valley obtain their domestic water supplies from wells. The remaining 1,088,000 persons in the Valley, 1948 population 1,905,000, live in small towns or in rural areas and obtain their drinking water from irrigation canals or farm wells. Fishermen and hunters regularly drink raw water directly from the mountain streams. Total water consumption for domestic purposes is estimated roughly at 400,000 acre-feet annually. Industrial water consumption is estimated to be 75 percent of the domestic consumption or 300,000 acre-feet annually.

Control of both the bacterial and mineral quality of irrigation water is of utmost importance to irrigated agriculture. Contaminated water used in irrigation of vegetable or fruit crops eaten raw could be a hazard to large areas of the United States as crops produced in the Central Valley are widely distributed. Relatively high concentration of certain dissolved salts such as sodium and boron are harmful to plant growth and to soils. The average mineral content of water samples collected from the Sacramento River above Sacramento has increased from 113 ppm. in 1908 to 160 ppm. in 1945 indicating a definite trend that may be of great importance.

The ground water in the Northern part of the Central Valley is of excellent quality, the total solubles usually being below 200 ppm. as compared with 300 ppm. for the Eastern part and 400 ppm. in most of the Western part.

The installed electric power generating capacity in the Central Valley consisted of 1,221,130 kilowatts of hydro capacity and 552,140 kilowatts of stream capacity in 1946. New projects, both steam and hydroelectric, completed, under construction, or definitely projected from 1946 to 1949 totaled 1,219,000 kilowatts. During normal water years from 90 to 95 percent of the energy consumed in the Valley is generated in hydroelectric plants. Dams built primarily for power are also of value in flood control and water conservation.

Waters of the Central Valley Basin support a commercial fishery for salmon and steelhead valued at over two million dollars annually. In addition, there are minor commercial fisheries for shad and catfish and important sport fisheries for striped bass, large and small-mouthed bass, catfish, crappie, sunfish and steelhead. In 1941, there were over 203 thousand licensed anglers. The growth of the recreational use of the streams is shown by an increase of 56 percent in the number of angling licenses between 1930 and 1940.

The maintenance of maximum use of the streams for these fisheries depends on the preservation of satisfactory minimum flows, retaining natural conditions and on the absence of pollution on the spawning grounds, on a minimum disturbance of the natural brackish water gradients in the lower reaches of the rivers, and in maximum use of canal screens, fish ladders and other devices needed to compensate for the disturbance of natural conditions. Favorable water conditions for cold water species exist in the mountains. At intermediate altitudes, dams adversely affect the migrations of anadromous species and reservoirs threaten the survival and growth of certain more valuable species. In the lower reaches of the rivers, changing flows and abnormal salinity ranges threaten normal levels of production.

Millions of migratory waterfowl use the Central Valley Basin. Game hunters in the area number about 70,000 annually and provide a recreational resource income estimated conservatively at over 20 million dollars per year.

A channel with 31 feet navigation depth opens the Port of Sacramento to ocean-going vessels. A navigation depth of 5 feet extends for 130 miles above Sacramento to Chico Landing. Water

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depths suitable for navigation are maintained over long stretches of the Sacramento and San Joaquin Rivers. On the San Joaquin, the watercourse to Stockton is used for ocean-going vessels. Important recreational use lies in the facilities for boating and swimming provided by hundreds of miles of streams, irrigation canals, and other waterways. Principal factors limiting such activities are marked seasonal variation in stream flow and pollution. Current reservoir developments, yielding greater stream flow, and improved waste treatment facilities are expected to enhance the recreational potentials of the Basin.

Need for Treatment Works

The requirements for sewage and industrial waste treatment plants are shown on the following table. Available data indicate that 73 new treatment plants should be provided and that 55 existing plants should be improved for the municipalities and industries in the Basin. The information on municipal plants covers all larger communities and is believed to be fairly complete; but the estimate for industries is no doubt low. Additional studies should be made of the industries, particularly the wineries and food processing plants which have difficult waste disposal problems.

The inadequate information on and seasonal character of industrial wastes discharges make it difficult to accurately estimate the cost of needed construction. For purposes of this report, the cost of new treatment works and additions to existing treatment works required in the Central Valley is roughly estimated at $30,000,000. Since the major water uses, irrigated agriculture, domestic and industrial water supply, sport fishing, and other recreational uses require water of high mineral and bacteriological quality, water pollution control is imperative and the cost nominal in comparison with the total cost of the Central Valley Project estimated at $1,810,800,000 by the Bureau of Reclamation in 1949.

Sewage and Industrial Waste Treatment Plant Requirements

Source (1)	Total No. (2)	Without Treatment			With Treatment			No Project Req'd (9)	No Data (10)
		No. (3)	Treatment Needed (4)	Status Unknown (5)	No. (6)	Improvements Req'd (7)	Status Unknown (8)		
Municipalities	158	46	46	0	108	52	0	56	4
Industrial Plants	61	27	27	0	9	3	0	6	25
Total	219	73	73	0	117	55	0	62	29

It should be noted the survey covers only 61 (column 2) industrial plants although the total number of plants in the basin is estimated at more than 1600 including 131 known wineries. Many of the industries are served by municipal sewer systems.

PART II

BENEFITS AND COSTS

Benefits from Water Pollution Control

Anticipated benefits from water pollution control in the Central Valley are:

(1) Savings to municipalities and industries made possible by the availability of water supplies satisfactory for domestic and industrial use without expensive treatment. This benefit is greatest in the rapidly expanding San Francisco Bay Area where 1,720,000 people and numerous industries now use surface water from Central Valley streams with no treatment other than chlorination. Any significant increase in bacterial content or turbidity of the raw water would require provision of costly treatment including chemical coagulation and filtration.

(2) Protection to the agricultural industry by assurance of continued sources of water of satisfactory quality for irrigation. An epidemic of water-borne disease traceable to fruit or vegetables contaminated by polluted irrigation water could be as disastrous to the agricultural industry as similar epidemics 25 years ago were to the shellfish industry. Increases in certain mineral constituents could also make the water unsuitable for irrigation.

(3) Reduction of hazards to health. At present, extensive acreages of the Valley in national parks and forests attract large numbers of visitors who camp and hunt near reservoirs, lakes and streams. A seasonal pressure of first magnitude, this hazard needs primary attention to safeguard the people's health against water-borne disease.

(4) Stimulation of recreational use, such as hunting, fishing, and camping, throughout thousands of acres of national parks and forests alone. Pollution of otherwise useable waters has reduced the boating and other recreational activities in particular sections.

(5) Preservation and growth of the valuable fisheries of the area. Three major anadromous species of California--salmon, striped bass and shad--largely depend on the Central Valley streams for spawning grounds. Also, there are numerous resident species including Sacramento pike, fork-tail catfish, small-mouthed black

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bass, large-mouthed black bass, bluegill and crappie. The sport fishery for salmon alone is valued at around $950,000 annually. Licensed anglers number several hundred thousand, and their general expenditures provide a large source of income to numerous communities especially in and around the Delta area.

The principal commercial fisheries in the Central Valley are salmon and shad. The annual value of the salmon catch is around $350,000.

Silting of streams and pollution from domestic and industrial sources have destroyed valuable spawning grounds and produced unfavorable stream conditions for fish. These factors, together with man-made water diversions, threaten the maintenance of the Central Valley fisheries.

(6) Improvements in appearance and value of shore properties; such improvements are sorely needed in numerous communities and potential recreational sites along the many miles of watercourses at the lower levels of the Valley Basin.

PART III

SPECIFIC POLICY PROBLEMS

Resolution of Apparent Conflicts Between Upstream and Downstream Interests in the Use of Water Resources of the Basin

In California, legislation enacted in 1949 established a state water pollution control board and nine regional boards to coordinate the actions of the various state agencies and political subdivisions of the state in the control of water pollution. The State Board, in a progress report of its Committee on Water Criteria, March 2, 1950, considers the total interest in utilization of water resources and the conflicts involved. This tentative committee report proposes a method of analysis of waste disposal problems which recognizes the need for economical waste disposal as well as the need for protection of water quality for beneficial uses.

This progress report is reproduced below for it indicates the probable approach that will be followed in resolving conflicts between upstream and downstream interests in California's Central Valley insofar as water pollution problems are concerned:

"PROGRESS REPORT OF
COMMITTEE ON WATER QUALITY CRITERIA
MARCH 2, 1950

(TENTATIVE)

In every area of varied topography and land and water use, there develops sooner or later a general pattern of water quality zones. This happens whether there is definite conscious planning by governmental agencies or whether matters are left to take their own course and whether conflicting interests adjust their differences by peaceful means or whether differences are settled in law courts. In a very general sense, the result is the same. In primitive catchment areas of little or no habitation and industry, streams remain largely in their natural state and quality of water is generally good. In the flat valley and plains areas, streams receive return drainage from irrigation, and at scattered locations, wastes from the sewer systems of towns

and industries. The quality of water in streams in this area is moderately polluted although not uniformly so, but is still salvageable for most uses.

Then lastly, there are areas near the mouths of streams or near bays and harbors where wastes from cities and industries are concentrated, and pollution, of surface waters at least, renders water unfit for those uses requiring water of a high degree of purity.

Such a pattern has already developed in California, and one might easily indicate these three zones roughly on a map of the State with respect to surface waters.

Because such patterns always seem to take shape, many states have built their programs of control of water pollution upon a basis of planned zoning of streams according to major uses (and abuses) of water, and within each zone have established water quality standards designed to be consistent with those uses.

This method of regulation has certain very powerful advantages; it lets waste-producing agencies and activities know very definitely where they stand, and it furnishes a simple basis for administration of a governmental control program. On the other hand, the method has equally compelling objections, at least when applied to California, which cannot be lightly set aside. These objections are dealt with in the following paragraphs.

First of all, the uses of waters within a zone are by no means uniform throughout a zone. Take, for example, the coastal or bay waters. In some areas such waters are inaccessible or by reason of temperature or currents unusable for any recreational purpose while in other areas such waters may be used not only for swimming and bathing but also for shellfish culture or the fluming and processing of fish in fish canneries.

Secondly, the effects of pollution are not uniformly dispersed throughout a zone from a source of pollution but are restricted in geographical extent. Consequently, it is possible for highly exacting uses of water and sources of pollution of water to exist harmoniously in the same zone if properly related to each other geographically.

Thirdly, the successful program must recognize that the need for economical waste disposal is just as exacting as the need for protection of water quality for beneficial uses, for lacking either, there can be no sound development. Waste treatment always consists of a combination of artificial treatment and utilization of resources of natural purification, and economy in waste disposal requires that maximum emphasis be placed on the latter. This is only possible if the requirements in the disposal of any waste take into account the relative geographical locations of the point of discharge and the points of beneficial usage so that full utilization may be had of the factors of natural purification in the intervening area.

Lastly, perhaps the greatest limitation to a zoning program is that it always tends to be fixed or permanent, and does not lend itself to a program of reclaiming lost water quality or upgrading a degraded area.

For these reasons, it is the firm conviction of the members of the committee on water quality criteria that a method of establishing the requirements of waste disposal in each region must be followed which will take into account the following key points:

1. The total interest in a water pollution control program encompasses both economical waste disposal and preservation of the beneficial uses of water.

2. Requirements as to waste disposal must recognize the zone of influence of wastes with respect to bacterial, biochemical, physical and chemical effects, and be only so severe as to protect some beneficial use of water (including simple aesthetic enjoyment) within such zones of influence.

3. Account must be taken of both the present and future planned quality of a receiving water in setting requirements for disposal of a waste.

4. Requirements in all cases must be reached by logical analysis of all of the pertinent factors of a given problem rather than by simple reference to an arbitrary general rule so that when examined judicially in court they will not be reversed.

5. The definition of "pollution" in the law is restricted to impairments of water quality which unreasonably affect such waters for beneficial use.

It is to be expected that some beneficial uses of water will suffer to some extent from disposal of wastes. In order to insure that such detrimental effects are not "unreasonable," account must be taken of the fact that every beneficial use imposes two values to each of its water quality requirements: first, an optimum value, below which the use is not damaged to any significant degree by pollution, and second, a maximum or limiting value above which the beneficial use is to all practicable purposes inhibited or destroyed. There has been prepared and attached hereto a table showing the optimum and limiting values of water characteristics which pertain to each type of beneficial usage. (Note by P.H.S. - Table not included in this report.)

6. Account must be taken of the fact that ground waters are of paramount importance in California, and that damage to ground waters is long-lasting if not permanent in nature whereas surface waters recover rapidly when the source of pollution is removed. For this reason risks of accidental pollution infrequent in occurrence that might be tolerated for surface waters, must not be tolerated where the quality of ground waters is at stake.

Based on the foregoing considerations, there is hereunder set forth a method of analysis of waste disposal problems to be used as a basis of arriving at appropriate requirements pertaining to a waste which will prevent "pollution" as defined in the statute.

METHOD OF ANALYSIS OF WASTE DISPOSAL PROBLEMS

PART I - Comparison of the relative public and private "interest" in solving the waste problem, with the "interest" in preserving the beneficial uses of water involved.

Step 1 - For the discharge in question, record the following information or facts:

a. Necessity of the disposal.

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b. Assessed valuation of the source of the waste (industry, city, etc.).
c. Number of people identified with the source of the waste (industry, city, etc.).

Step 2 - Determine or estimate for the waste and receiving body of water in question, the zones of influence with respect to:

a. Bacterial effects.
b. Biochemical effects.
c. Physical effects.
d. Chemical effects.

Step 3 - Within the appropriate zone of influence, list the beneficial uses of water affected and for each separate beneficial use, list the following information:

a. Necessity for the use.
b. Assessed valuation involved in the beneficial use (farm, city, industry, etc.).
c. Number of people identified with the beneficial use.

PART II - Effects of discharge of wastes.

Step 1 - For the discharge in question, record the following data:

a. Liquid volume of waste in gal/day.
b. Bacterial, biochemical, physical and chemical characteristics of the waste.

Step 2 - For that portion of the receiving body of water as will be intermixed with the waste, record the following data:

a. Volume of "flow" in cu. ft./sec.
b. Bacterial, biochemical, physical and chemical characteristics before discharge is made.
c. Bacterial, biochemical, physical and chemical characteristics after discharge is made.

Step 3 - For each beneficial use affected by the waste, record the following data:

a. Volume of water "used" in gal/day.
b. Optimum bacterial, biochemical, physical and chemical characteristics associated with the beneficial use.
c. Maximum or limiting values of bacterial, biochemical, physical or chemical characteristics beyond which beneficial use would to practical purposes be destroyed.

PART III - Balancing requirements of waste disposal against those of water use:

Step 1 - From the data in Steps 2 and 3 of Part II tabulate the following:

a. Beneficial uses "destroyed" by the waste discharge.
b. Beneficial uses damaged but not destroyed by waste discharge.

Step 2 - From the data in the preceding steps, compute the degree of "treatment" and cost of "treatment" to do the following:

a. Maintain at least limiting values of the quality characteristics required by each beneficial use (at point of use).
b. Maintain optimum values of the quality characteristics required by each beneficial use (at point of use).

Step 3 - On the basis of the data in Steps 1 and 2 of this Part, and in view of the relative values shown in Part I, determine by the exercise of judgment:

a. Those uses for which optimum values of quality characteristics are to be maintained.
b. Those uses for which values of quality characteristics exceeding the optimum but not exceeding the limiting are to be maintained.
c. For those uses in Section (b) above, the degree by which the optimum values of quality characteristics may be exceeded to accomplish the best over-all solution to the problem.

Step 4 - Translate the decisions reached in Step 3 of this Part into actual effluent requirements.

It is acknowledged that the foregoing method is a combination of objective and subjective procedures, but this is inescapable if the decisions are to be reasonable and judicial as provided in the statute."

Problem of Securing Adequate Basic Data

Specific information on industrial waste discharges to surface and underground waters in California for the Central Valley is currently available from the State Department of Public Health for those places where, in the past, problems or complaints have required special studies. There is no comprehensive data available. Field surveys and studies are needed to secure this information.

Authority for control of industrial waste pollution has been delegated by Chapter 1549, Division 7 of the California Water Code, enacted July 28, 1949, to Regional Water Pollution Control Boards. One of these Boards was established for the Central Valley.

Therefore, it appears that the assembly of specific information on industrial wastes would be the duty of this Board. Its technical staff is limited but it is empowered to call on other units of State government to inspect and report on any technical factors involved in water pollution or nuisance.

Information on domestic sewage waste disposals is available in more detail from the State Department of Health, but in some cases field visits would be required for data to be applicable and correct as of current date.

The principal problem is one of manpower shortage to carry out the necessary field work on the part of both of these State agencies.

Problem of Securing Local Participation

Contacts between the River Basin Office of the Public Health Service and state and local agencies to develop cooperative support and interest in the national water pollution control program have resulted without exception in assurances of cooperation to the degree that resources will permit. An obstacle, which it is believed may rapidly be overcome, has been the necessary lag in

implementation of the water pollution control legislation enacted in California in 1949. This legislation makes a drastic change in the administration of water pollution control activities in the State. Appointment of numerous Boards, technical staffs, etc. was necessarily a slow moving process. In the interim, state agencies formerly responsible for duties they no longer have, were hesitant to act in any matter that would be interpreted as of a policy-making nature or a continuation of responsibilities they formerly held.

SUPPLEMENT "A" (MOSQUITOES)*

THE CENTRAL VALLEY BASIN

Summary

The physical features of the Basin described in the report to which this is appended is adequately informative for the purposes of this supplement.

The development of water control and use programs in the basin has been intense during the past half-century or less. Current development and planning are for an acceleration of this development.

The development of mosquito control, on the other hand, has been and is geared almost entirely to the health and comfort requirements of the basin population. Since these requirements receive secondary consideration by man--his primary concern involving the means for making and maintaining a livelihood--the historical development of mosquito control has been taking place not only after water control and use projects have been completed but not until the necessity therefor has been forcibly impressed upon the population by occurrence of a malaria or encephalitis outbreak or the attack of pestiferous hordes of mosquitoes which reduce milk or egg production, depreciate property values, or render otherwise well-designed recreational sites intolerable for human enjoyment.

Preventive planning and consideration of factors related to the public health benefit and enjoyment of water control and use projects is as fundamental as is planning and consideration of the factors related to structural safety or adequacy thereof.

Prerequisites to Mosquito Prevention and Control

Unlike the pollution of streams which is usually traceable to some specific focal point, or points of origin which may lend

* Prepared by Sanitary Engineer i/c Water Resources Development Section, State of California Department of Public Health, Bureau of Vector Control, Berkeley, California and Public Health Service, Communicable Disease Center, Atlanta, Georgia.

themselves to concentration or conveyance, the sources of mosquitoes are much more numerous and widely dispersed and are not generally adapted to concentration or transferral to another site for treatment. Similar to pollution control, however, which leans heavily upon prevention or control by means of reducing the number of, or modifying responsible sources or methods, the control of mosquitoes is most economically and reliably accomplished through elimination or alteration of the causative sources or conditions. Needless to say this must be, and is invariably effected within limits which are consistent with the primary purpose of the project.

The creation of water surfaces, suitable for the production of mosquitoes, regardless of their size, either by design or by accident must be guarded against. Estimation of these conditions is not possible by empirical formulations, therefore, individual project evaluation or appraisal by persons familiar with the strange ways of mosquitoes and the acceptable methods for control is required. The responsibility for failure to consider this and the resultant cost for corrective mosquito control must be assumed by the responsible party or parties and should not be forced upon the citizenry who have no prior knowledge of the problems being created.

During the critical water years 1928-34 an average of a little less than 3,000,000 acres were irrigated annually which is only 45% of the total irrigable area of the basin. The average annual increase during the next decade amounted to about 67,000 acres per year.(1) The presently authorized federal Central Valley Project, excepting the American River Service Area, includes new and supplemental water supplies sufficient to produce the equivalent to almost 2,000,000 acres of newly irrigated land. This development is expected to be nearly complete by June 30, 1956 and is scheduled for completion at the rate of about 114,000 acres per year (2) or nearly double the historic rate of increase. In addition to this private power, local irrigation and utility district, recreational, fish and wildlife and similar developmental and recreational activities are moving ahead at an accelerated pace.

(1) Central Valley Project Studies, Economic Effects Problem 24, U. S. Dept. of the Interior, Bureau of Reclamation, U. S. Gov't. Prtg. Office, 1949.

(2) Bureau of Reclamation, Schedule of Advance Construction Program Fiscal Years 1950-56. Authorized Projects (Office of Program and Finance, Prepared October 22, 1949).

If we may believe the experience of others (1), (2) we are undoubtedly setting the stage for possible malaria or encephalitis outbreaks and the ultimate abandonment of certain areas for the profitable pasturing of cattle, milk and poultry production and the comfort and enjoyment of man.

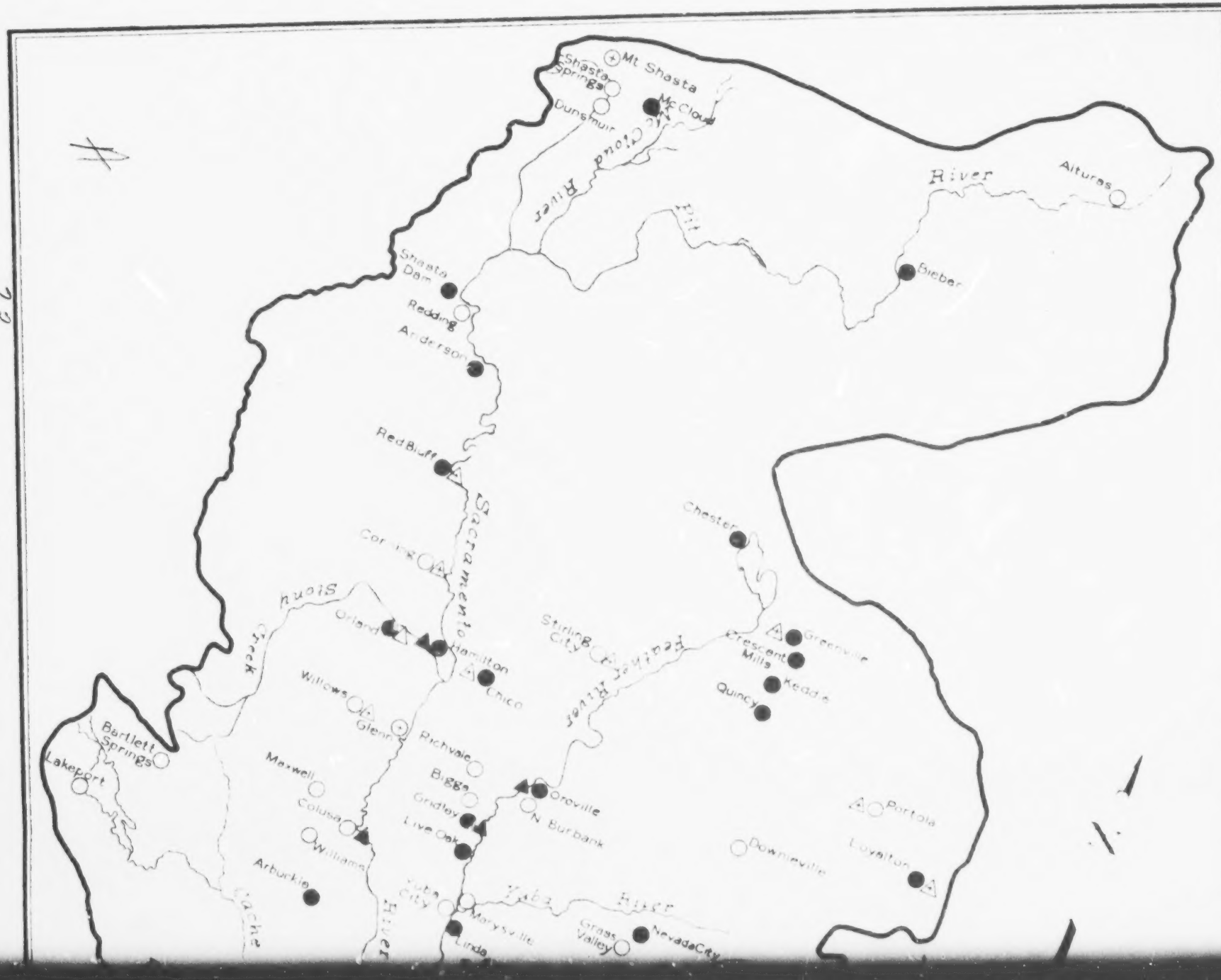
The 32 organized mosquito abatement agencies within the basin derive their incomes from taxes--economically, they are not prepared to cope with an ever-growing increase in mosquito control requirement. They now serve a little more than 16,000 square miles or about 27% of the area contained within the drainage basin. Aside from the additional financial strain which faces these areas much of the unprotected 73% will have to face the prospects of organizing for mosquito abatement as the intensity of mosquito production increases in the populated, dairy and cattle producing, recreational, irrigated, and similar areas where the health and comfort of man and domestic animals is jeopardized.

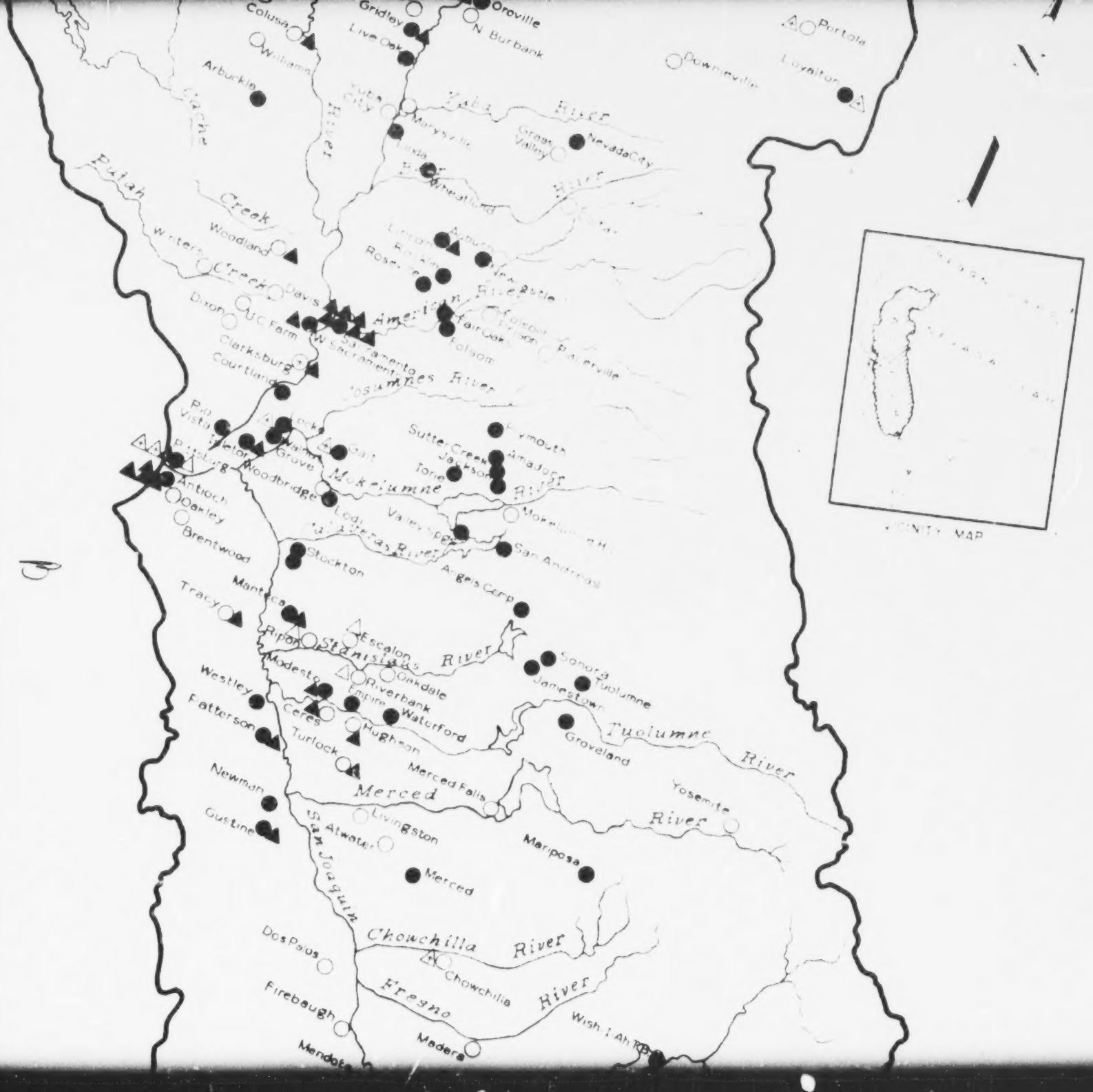
It is a warranted conclusion that proper cognizance of mosquito interests must receive immediate recognition and that adequate representation of these interests in the planning, design, construction, operation, and use phases of water control projects of any magnitude must be provided for if we are to expect any improvement over the historic situation which still prevails.

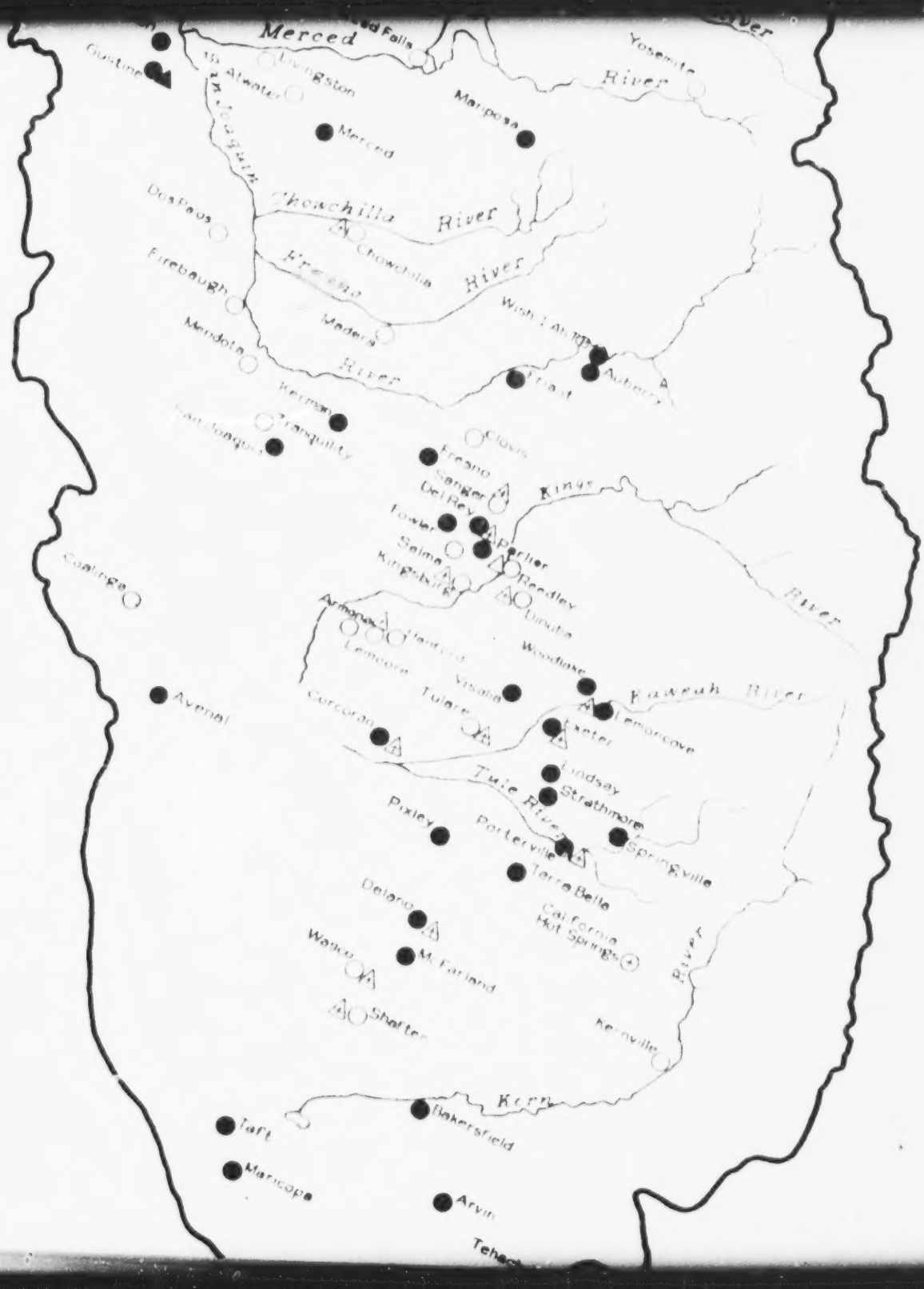
Descriptions, statistics, histories, and the like are of little significance until the principles of recognition and representation are authoritatively accepted on a basin-wide and individual project basis.

(1) Malaria Control on Impounded Waters, U. S. Public Health Service and TVA, U. S. Gov't. Prtg. Office, 1947.

(2) Mosquito Control, Herms and Gray, 2nd ed., The Commonwealth Fund, 1944.


Mt Shasta
Shasta Springs
Dunsmuir
McCloud
Pit River
Alturas
Bieber
Shasta Dam
Redding
Anderson
Red Bluff
Sacramento River
Cottonwood
Corning
Chester
Stony Creek
Orland
Hamilton
Chico
Willows
Glenn
Richvale
Bartlett Springs
Lakeport
Maxwell
Biggs
Gridley
Colusa
Live Oak
Williams
Arbuckle
Oroville
N Burbank
Stirling City
Feather River
Greenville
Prescent Mills
Keddie
Quincy
Portola
Loyalton
Downieville
Yuba City
Marysville
Linda
Yuba River
Grass Valley
Nevada City


Colusa
Gridley
Oroville
N. Burbank
Live Oak
Williams
Arbuckle
Portola
Loyalton
Downieville
Yuba City
Marysville
Yuba River
Grass Valley
Nevada City
Wheatland
Feather River
Auburn
Folsom
Placerville
Fairoaks
Rosemont
Woodland
Davis
Dixon
UC Farm
W. Sacramento
Clarksburg
Courtland
Sacramento River
Pittsburg
Antioch
Oakley
Brentwood
Walnut Grove
Woodbridge
Lodi
Stockton
Mokelumne River
Sutter Creek
Jackson
Ione
Plymouth
Amador
Valley Springs
Mokelumne Hill
San Andreas
Calaveras River
Angels Camp
Tracy
Manteca
Ripon
Escalon
Stanislaus River
Modesto
Oakdale
Riverbank
Empire
Waterford
Hughson
Ceres
Westley
Patterson
Turlock
Merced Falls
Tuolumne River
Sonora
Jamestown
Groveland
Yosemite
Newman
Gustine
Livingston
Atwater
Merced
San Joaquin
Mariposa
Dos Palos
Firebaugh
Chowchilla River
Fresno River
Madera
Mendota
Wishon Ahtel
Pulah Creek
Writers Creek
American River
Rio Vista
Lake
Farm
Grove
Woodbridge
Valley Springs
Mokelumne Hill
Angels Camp
Jamestown
Groveland
Yosemite
Chowchilla
Fresno River
Wishon Ahtel
VICINITY MAP


Merced
Yosemite
River
Livingston
Merced
Mariposa
Dos Palos
Chowchilla River
Chowchilla River
Fresno
Madera
Firebaugh
Mendota
River
Kerman
Tranquility
Clovis
Fresno
Sanger
Kings
Selma
Kingsburg
Reedley
Dinuba
River
Visalia
Woodlake
Kaweah River
Lemoncove
Tulare
Exeter
Lindsay
Strathmore
Tule River
Porterville
Springville
Pixley
Terra Bella
Delano
California Hot Springs
M. Farland
Wasco
Shafter
Kernville
Kern
Bakersfield
Taft
Maricopa
Arvin
Avenal
Coalinga
Corcoran

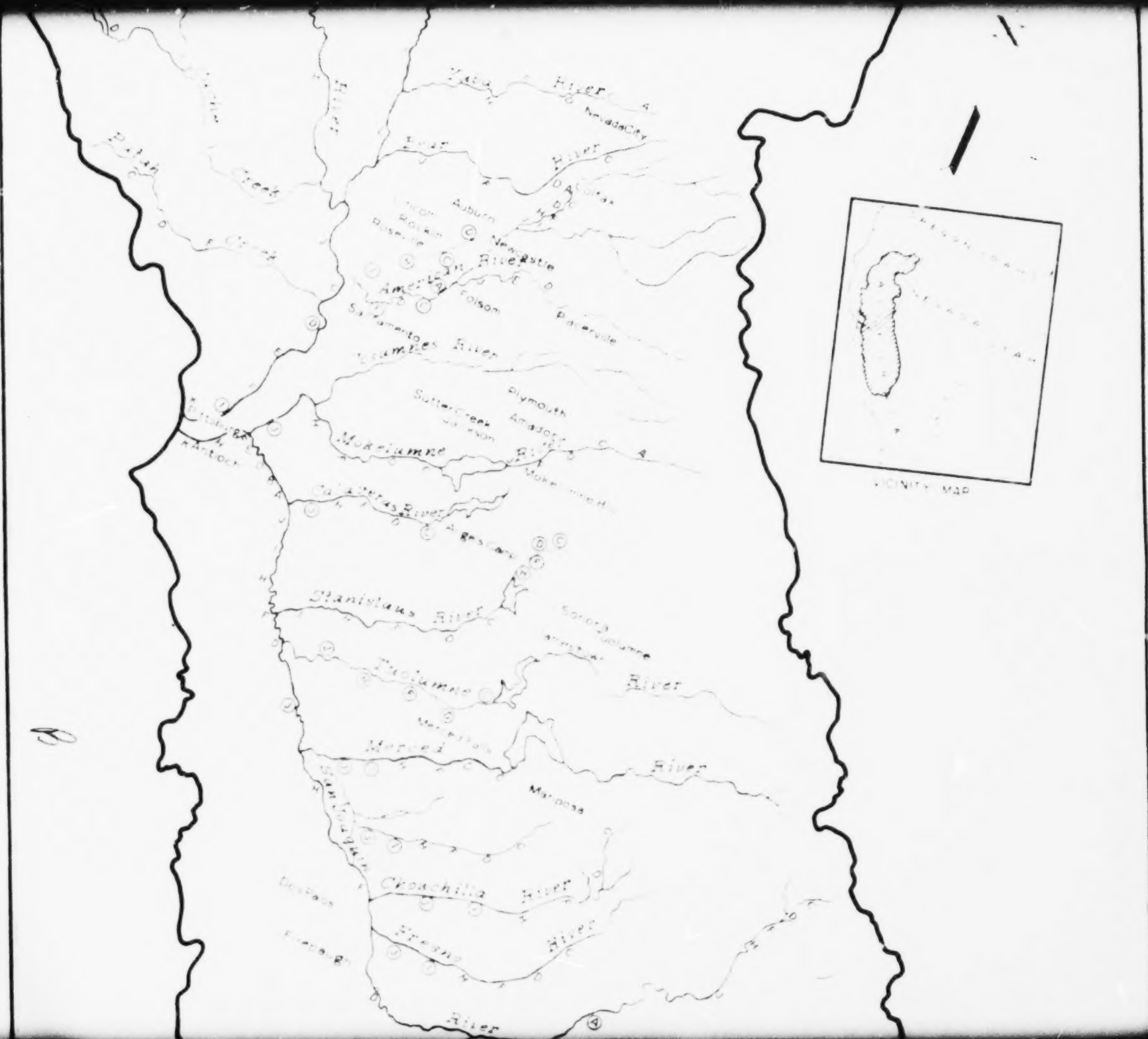
LEGEND

Industrial	Domestic	
△	○	No Project Required
▲	●	New or Additional Treatment Required
⊘	⊕	Treatment Status Unknown

SOURCES OF POLLUTION AND TREATMENT REQUIRED IN THE CENTRAL VALLEY OF CALIFORNIA

FEDERAL SECURITY AGENCY
PUBLIC HEALTH SERVICE
DIVISION OF WATER POLLUTION CONTROL

River
Pit
Mc Cloud River
Sacramento
Red Bluff
Quincy
Oroville
Feather River
Yuba River
Middle Fork
Stony Creek
Butte Creek
Putah


Yuba River
Auburn
Newcastle
Folsom
Placerville
Plymouth
Amador
Mokelumne River
Calaveras River
Stanislaus River
Tuolumne River
Merced River
Chowchilla River
Fresno River
VICINITY MAP

River
Kanawha River
Kings
Terra Belle
Kern
Merced River
Merced
Stanislaus
Chowchilla River
Streams
River
Deadman
Creek
B
C

LEGEND

A - Domestic Water Supply
B - Industrial Water Supply
C - Livestock Water Supply
D - Irrigation Water Supply
E - Commercial Fishing
F - Game Fishing
G - Shellfish
H - Wildlife
I - Bathing Water
J - Other Recreation
K - Navigation
L - Other Legitimate Uses

◯ - Water use for which stream is unsatisfactory is encircled

WATER USE AND ADEQUACY OF WATER FOR INDICATED USES IN THE CENTRAL VALLEY OF CALIFORNIA

FEDERAL SECURITY AGENCY
PUBLIC HEALTH SERVICE
DIVISION OF WATER POLLUTION CONTROL